ISSN 0704-3716

Canadian Translation of Fisheries and Aquatic Sciences

No. 5341

The morphology and systematics of the genus Nais Mueller (Oligochaeta, naididae) in Lake Baikal

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Original title: K morfologii i sistematike roda Nais Mueller (Oligochaeta, naididae) v Ozere Baikal

In: Izvestiya Sibirskogo Otdeleniya Akademii Nauk SSSR. Seriya Biologicheskih Nauk, (1): 69-75, 1984

Original language: Russian

Available from:
Canada Institute for Scientific and Technical Information
National Research Council
Ottawa, Ontario, Canada K1A 0S2

1988

19 typescript pages

Secretary of State / Secrétariat d'État

90-01477/(

MULTILINGUAL SERVICES DIVISION – DIVISION DES SERVICES MULTILINGUES

TRANSLATION BUREAU BUREAU DES TRADUCTIONS

LIBRARY IDENTIFICATION – FICHE SIGNALÉTIQUE

Translated from - Traduction de	Into - En
Russian	English

Author - Auteur

V.P. Semernoi

Title in English or French - Titre anglais ou français

THE MORPHOLOGY AND SYSTEMATICS OF THE GENUS NAIS MULLER (OLIGOCHAETA, NAIDIDAE) IN LAKE BAIKAL

Title in foreign language (Transliterate foreign characters)
Titre en langue étrangère (Transcrire en caractères romains)

K MORFOLOGII I SISTEMATIKE RODA NAIS MULLER (OLIGOCHAETA, NAIDIDAE) V OZERE BAIKAL

Reference in foreign language (Name of book or publication) in full, transliterate foreign characters.
Référence en langue étrangère (Nom du livre ou publication), au complet, transcrire en caractères romains.

[not provided with translation request]

Reference in English or French - Référence en anglais ou français

Publication info	DATE OF PUBLICATION / DATE DE PUBLICATION			Page Numbers in original / Numéros des pages dans l'original
Publisher - Editeur	Year / Année	Volume	Issue No. / Numéro	69–75
Place of Publication / Lieu de publication: [USSR]				Number of typed pages / Nombre de pages dactylographiées: 17

Requesting Department / Ministère-Client: DFO

Translation Bureau No. / Notre dossier nº: 3287262

Branch or Division / Direction ou Division: IPB

Translator (Initials) / Traducteur (Initiales): MW

Person requesting / Demandé par: R.O. Brinkhurst

Your Number / Votre dossier nº: –

Date of Request / Date de la demande: November 13, 1987

UNEDITED TRANSLATION
For information only
TRADUCTION NON REVISEE
Information seulement

Canada

SEC 5-111 (84-10)

Department of the Secretary of State of Canada | Secrétariat d'État du Canada

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Client's No.–N° du client	Department – Ministère	Division/Branch – Division/Direction	City – Ville
–	DFO	IPB	Ottawa
Bureau No.–N° du bureau	**Language – Langue**	**Translator (Initials) – Traducteur (Initiales)**	
3287262	Russian	MW	DEC 11 1987

Source: [not provided with translation request]

THE MORPHOLOGY AND SYSTEMATICS OF THE GENUS NAIS MÜLLER (OLIGOCHAETA, NAIDIDAE) IN LAKE BAIKAL

Nine species of the genus Nais have been known until now in /69* Lake Baikal from published sources: N. barbata Müller (N. obtusa Gervais) [1-6]; N. variabilis Piquet [7-9]; N. bekmani Sok.; N. baicalensis Sok.; Nais koshovi Sok. [7]; N. tygrina Isoss [10, 11]; Nais sp. [7]; N. communis Piquet; N. elingues [12]; and N. simplex Piquet [8].

An analysis of the collections of oligochaetes found in the holdings of the Limnological Institute, Siberian Branch, USSR Academy of Sciences, and of our own collections has shown that the lake is also inhibited by other forms of the genus Nais, not recorded in previous studies. Particularly interesting material is provided by the collections from the mesobenthos in the littoral and sublittoral portions of Southern and Northern Baikal (July 1978 and 1982, expeditions of the Limnological Institute under the supervision of G.F. Mazepova).

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*Translator's note: Numbers in the right-hand margin refer to the corresponding page in the Russian text.

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Nais tygrina Isossimov, 1962 /70

(Figure 1)

N. tygrina [10, 11]; Nais sp. [7]; N. tygrina [14--note to N. barbata].

The initial information on this species in the works of V.V. Izosimov on the fauna and systematics of the Lumbriculidae does not contain an adequate description of its morphological features, except for brief remarks on the presence of pigmented bands on the dorsum of the somites and a double number of setae in its abdominal bundles in comparison with N. barbata.

A fuller description of the species was given by N.L. Sokol'skaya [7] as a characterization of the form Nais sp., which the author tentatively ascribed to N. tygrina.

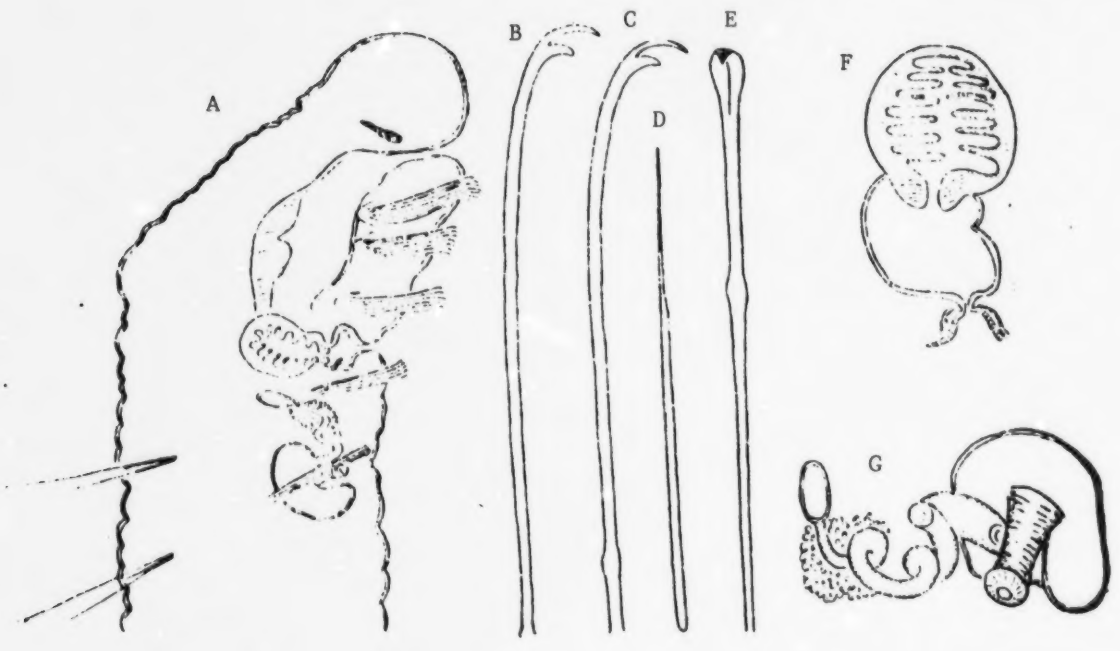
We found typical specimens of N. tygrina, with clearly marked features of pigmentation and a double number of setae, in the littoral of Northern Baikal.

In this paper we propose a broader diagnosis of the species with an indication of the limits of variation of mensural features for individuals from different habitats.

Description: The length of an immobilized single individual is 2.5 to 7 mm; the length of a chain consisting of two or three living zooids reaches 20 mm. The body in cross section at segment VI of immobilized specimens is 0.5 to 0.7 mm. This is probably the largest species of the genus. The number of segments in a solitary individual reaches 40 (see Figure 1).

FIGURE 1

Nais tygrina Isossimov, 1949



A: general appearance of the anterior end

B: abdominal seta of segment 2

C: abdominal seta of segment 10

D: needlelike seta of the dorsal bundles

F: spermatheca

G: male gonoduct

The prostomium is massive and round. The eyes are very large.

There are transverse bands of dark brown or cherry-colored pigment dorsally on both sides of the intrasegmental furrows, which pass down the sides. The entire body is pigmented.

The abdominal setae are uniform in shape in the bundles of he larval and postlarval segments, with an upper tooth 2 to 2.5 times longer than the lower tooth, with a proximal nodule.

There are 3 to 12 setae in segment II with a length of 150 to 250 microns; 3 to 12 (150 to 330 microns) in segment III; 3 to 10 setae in segments IV and V, 150 to 250 microns long.

The abdominal bundles of the postlarval segments contain 4 to 14 (15) setae, 134 to 255 microns long (in the most typical specimens the setae are distributed in two rows).

The abdominal setae of segment VI in sexually mature /71
individuals are replaced by 5 to 8 penial setae, up to 300 microns long, with a hook-like recurved distal end in the form of a flat spoon with a keel-like ridge on the inner surface.

The dorsal bundles of setae begin with segment VI and contain needlelike and hairlike setae. The needle-shaped setae are 2 to 4 per bundle and 63 to 130 microns long, with a finely drawn out distal end. The hairlike setae are 1 to 3 per bundle with a length of 500 microns or more.

Reproductive system: The seminal funnel is small, approximately in the middle of dissepiment V/VI. The vas deferens is long, coiled, and covered with prostate cells in the first quarter; it descends into the ampulla of the atrium in front downward, near the base of the efferent section, and it expands during its descent. The

ampulla of the atrium consists of two parts, an anterior round part (diameter: 170 microns) and a posterior, narrower part, curved downward. The efferent section (ejaculatory duct) is rather long (110 microns) and sinewy.

The spermatheca is very unusual; it consists of two ampullae, a thin-walled hollow ampulla and a second (upper) with a thicker wall and with long glandular septa; the ampullae are of equal diameter (170 microns). There is practically no efferent section; the sphermathecal pore opens immediately into the hollow ampulla of the spermatheca.

The seminal sac and ovisac extend to segments XI and XII.

Lecotype No. 43355. Zoological Institute, USSR Academy of Sciences.

Locality: Baikal, Cape Kabanii, depth of 3 m, in rock accumulations, 18 July 1982.

Range: Baikal, littoral up to 10 m, reservoir of the Angara cascade.

The pigmented bands on the dorsum and the doubled row of setae in the abdominal bundles--features that were noted by V.V. Izosimov [10, 11] are the primary morphological features that distinguish this species. The doubling of setae is not only noticeable because of their total number in comparison with Nais barbata and other species of the genus, but also for their location. The positioning of the abdominal setae in two rows of seven setae is very characteristic of large specimens from the eastern shore of Lake Baikal. The proximal ends of the setae are very fine. Moreover, there is almost always a second follicula next to the primary one, with 5 or 6 incompletely developed (or growing) setae.

N. tygrina gives the impression of a polypoid (diploid) species due to the fact that all of its organs appear doubled; the number of

TABLE

Setae	Location			
	Maloe More (P) *Nais* sp.	Northwest shore Southern Baikal (Cape Angasol'-skii)	Eastern shore Northern Baikal (Cape Kabanii)	Ust'-Ilim reservoir (from T.V. Akinshina)
Abdominal setae				
Larval				
2	4-7 / 218-255	6-8 / 260	12 / 300-360	3-4 / 165-172
3-5	4-7 / 155-193	6-8 / 212	12(3)-10(4, 5) / 330-280	6-3 / 172-150
Postlarval	4-7 / 134-160	10-11(15) / 170	14 / 255	6-8 / 155
Dorsal setae				
Needlelike	1-3 / 63-113	2 / 127	8 / 300	1-2 / 100
Hairlike	1-2 / 445	1-2 / 250	1-3 / 500	1-2 / 250

Note: The numerator indicates the number of setae; the denominator indicates their size in microns.

setae is double and there is a dual spermatheca, a dual ampulla of the atrium, a long vas deferens, a double number of penial setae, and the /72 length of the most typical individuals is unusual for species of the genus Nais.

In our description of the species, we have indicated the size of the setae with a large gap between the minimum and maximum sizes observed in worms from different regions of Baikal, as well as in individuals from Ust'-Ilim Reservoir, which were given by T.V. Akinshina (Biological Scientific Research Institute, Irkutsk University), and we therefore append a table of the mensural features of N. tygrina taken from different regions.

V.V. Izosimov brought N. tygrina together with Nais barbata Müller [10, 11]. In our view, however, these two species have nothing in common. N. barbata has postlarval segments characterized by abdominal setae with an upper tooth that is frequently shorter than the lower one and less than half as thick; its setae are coarse and extremely curved.

Nais similis Semernoy, sp. nov.

(Figure 2)

Description: The length of immobilized worms is 2.5 mm; the cross section at segment VII is 0.3 mm; the number of segments in a single individual is 18 to 20.

The prostomium is small and round; there are eyes.

The abdominal setae are uniform in the shape of their distal ends: the upper tooth is 1.5 times longer and thinner than the lower one. Segment II has 1 to 4 setae, 161 to 172 microns long; segment III

has 3 to 5 (170); segments IV and V have 4 or 5 setae, 144 to 150 microns long; the postlarval segments have 4 to 7 setae, 130 to 144 microns long, in the abdominal bundles.

The dorsal bundles begin with segment VI and contain 4 or 5 needlelike setae with a length of 127 to 145 microns, with fine, sharp distal ends; the nodule is medial or slightly distal and there are 4 or 5 strong, sword-shaped hairlike setae 200 to 300 microns long. When immersed, many of the hairlike setae show plumosity on the convex edge.

Holotype No. 43356. Zoological Institute, USSR Academy of Sciences.

Locality: Maloe More, Cape Ulan-Khyn, depth of 25 m, mud, 28 July 1982.

Range: Maloe More, depth of 5 to 25 m, mud, rock accumulations; Southern Baikal, Solzan settlement, depth of 2 m, rocks.

Externally this species is very similar to Nais barbata Müller, which is why it was named similis. The most characteristic feature of the species is the large number and the length and the shape of the needlelike setae, similar to N. barbata. There are significant differences between these two species, however: the abdominal setae of N. similis are uniform in shape in the larval and postlarval segments, the upper tooth being considerably longer than the lower one, while the setae of the postlarval segments of N. barbata are massive, very curved, and with the upper tooth shorter than the lower one and less than half as thick. Furthermore, the hairlike setae of N. similis are feathered, similar to those of N. baicalensis Sok. The presence of feathered, strong hairlike setae, curved like a sword, unites

FIGURE 2

Nais similis Semernoy, sp. nov.

A: abdominal seta of segment II
B: abdominal seta of segment IV
C: abdominal seta of segment XII
D: needlelike seta of the dorsal bundles

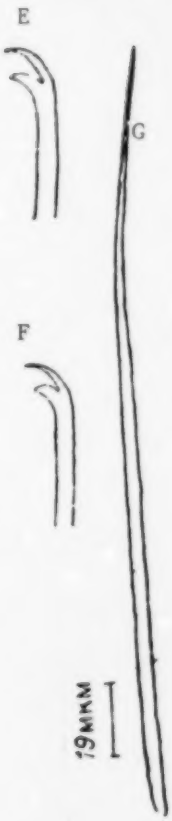


FIGURE 3

Nais tatijanae Semernoy, sp. nov.

E: abdominal seta of segment III
F: abdominal seta of the middle body
G: needlelike seta

N. similis with representatives of the genus Vejdovskyella Mich., in particular with V. comata, but, considering the huge differences in the shape and size of the abdominal and dorsal needlelike setae, the plumosity of the hairlike setae can be considered a convergent similarity.

Nais tatijanae Semernoy, sp. nov.

(Figure 3)

Description: The length of immobilized specimens is 2.5 to 3.5 mm; the cross section of the body at segment VII is 0.3 to 0.4 mm; there are 14 to 18 segments.

The prostomium is small and conical. There are eyes.

The abdominal setae of the larval and postlarval segments are identical in shape, with the upper tooth thinner and considerably longer than the lower one. The bundles of segment II have 3 to 6 setae, 212 to 263 microns long, with a proximal nodule. The bundles of segments III to V have 2 to 6 (usually 4 or 5) setae, 153 to 204 microns long (usually 127 to 170), with a fine nondentate distal end comprising one-third the length of the setae, and they have 2 or 3 hairlike setae up to 500 microns long.

The species is named after Tat'yana Shidlovkaya, who participated in gathering oligochaetes on the littoral of Southern Baikal.

Holotype No. 43357. Zoological Institute, USSR Academy of Sciences.

Locality: Maloe More, Cape Ulan-Khyn, depth of 5 m, sand, 28 July 1982.

Range: the littoral of Lake Baikal at depths of 5 to 25 m, on different terrain and in accumulations of rocks. It is one of the most frequently encountered species, particularly at Maloe More.

This species is in its general appearance most similar to Nais pseudobtusa Piquet and to N. simplex Piquet, but it differs from them in the longer and thinner distal tooth of its abdominal setae and in its longer and thinner needlelike setae.

Nais abissalis Semernoy, sp. nov.

(Figure 4)

Description: The length of the two zooids of the body is 1.5 mm; the cross section of the body at segment III is 0.35 mm; at segment VII, 0.28 mm.

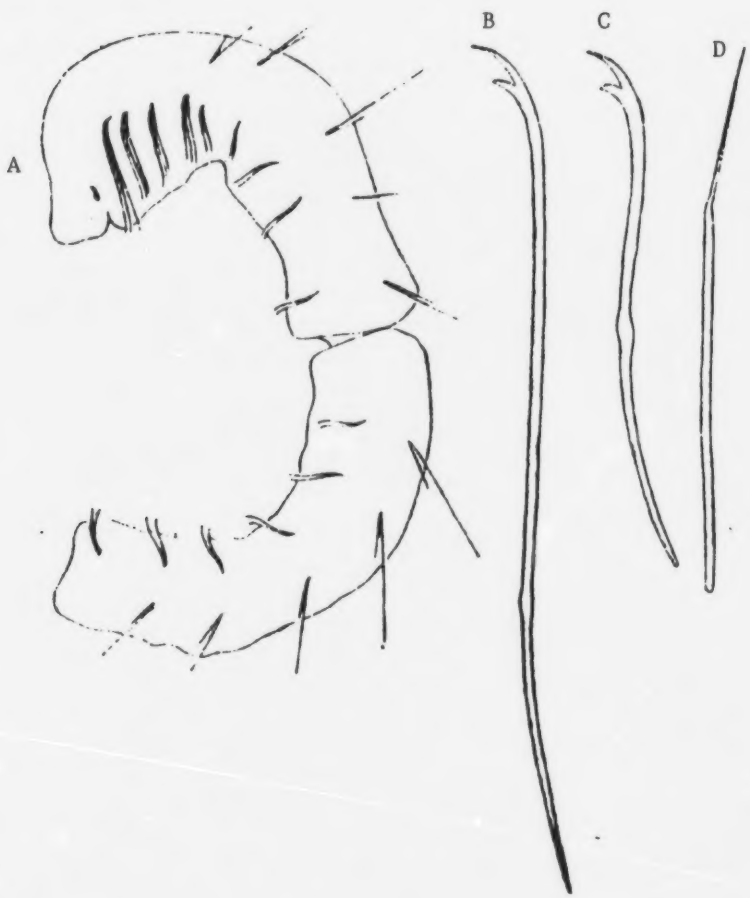
The prostomium is small and conical. There are eyes. The anterior segments are swollen dorsally. The tegmenta are smooth and transparent. There is no clear gastric distension.

The setal apparatus is typical of the genus. The abdominal bundles of the larval segments contain 2 or 3 double-toothed setae with the upper tooth 2.5 to 3 times longer than the lower one, with a proximal nodule. The setae of segment II are longer, 215 microns; those of segments III to V are 170 microns. The bundles in the postlarval segments contain 3 setae, 140 microns long, with the same relative tooth length, but much thicker than in the larval segments.

The dorsal bundles begin with segment VI; they contain 1 or 2 thin hairlike setae up to 340 microns long and usually 2 needlelike setae that are 107 microns long, with a sharply recurved distal end.

FIGURE 4

Nais abissalis Semernoy, sp. nov.



A: general appearance of a worm consisting of two zooids

B: abdominal seta of segment II

C: abdominal seta of the middle body

D: needlelike seta

Holotype: total preparation No. 43358. Zoological Institute, USSR Academy of Sciences.

Locality: Lake Baikal, Bolsodei harbor, depth of 700 m, mud, one immature specimen.

The species is named after the location where it was found. Until this time no representatives of the family Naididae had been known from such depths. This species belongs to the Nais group that possesses simply pointed needlelike setae. Among the Nais species known from Lake Baikal, N. abissalis is closest to N. simplex in the shape of its dorsal needlelike setae. Its distinctive features consist of the shape and size of its abdominal setae. The ecological distinctions between these two species are particularly important. While N. abissalis lives at a considerable depth, 700 m, N. simplex is usually encountered in the inshore zone of lakes and rivers among brush. The morphophysiological adaptation of this species to the specific conditions of such a depth, is due above all to the considerable saturation of the water with oxygen, even at the greatest depths of Lake Baikal. Among the Nais of Baikal we also find N. koshovi Sok. [1962], in which the dorsal bundles contain needlelike setae with finely recurved distal end. In our opinion, this species is more like the genus Veydovskyella Mich., since it does not have eyes, the hairlike setae are sturdy and curved like a sword, and the needlelike setae are straight, without the bend at the distal end that is characteristic of the genus Nais.

In summation, the list of species of the genus Nais from Lake Baikal, has been complemented with three more species, and there is reason to believe that the list will be added to in the immediate future.

The naidids are one of the most poorly studied families of oligochaetes of Baikal; there is only a single specialized work [7] that has been produced from the more than century-long history of studying the oligochaetes of this lake. The study of the naidids--alpha-taxonomy - of E. Mair [15]. At the same time, Baikal exhibits a wonderously broad range of morphological species variability, the analysis of which presents an unbounded field for activity at the level of beta and gamma-taxonomy.

The feathering of the hairlike setae of N. baicalensis, N. similis, and, evidently, N. bekmani can be called one of the distinguishing morphological features of the Baikal representatives of the genus Nais. This feature is encountered only in the naidid genera of Veydovskyella Mich. and Pristina Ehrenberg. It is encountered much more frequently in the family Tubificidae. It is difficult to imagine the possible genetic relationship in terms of this feature between the genera of the family Naididae and between the Naididae and the Tubificidae. The feathering of the hairlike setae can be considered one of the "old" primitive features that have been preserved from ancient times in some species of the genus Nais in the specific (conservative) environment of Baikal. Closely related species of widely distributed fauna, such as N. barbata and N. simplex, have already lost this feature. This feature can also serve as an index of the endemism of the Baikal Nais species. In our opinion, all of the morphological features that distinguish the Balkal species from closely related species of the Palaeoartic or of the Holartic fauna in general represent characteristics of morphological relicts, which undoubtedly had a wide distribution although they were only preserved in Baikal.

Consequently, the endemism of the Baikal species should only be considered from the position of the ancient, relict fauna of the lake.

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Received 31 May 1982

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*Translator's note: A sor is the underwater portion of a partly submerged valley.